

On such basis, the objection to claim 25 is overcome.

Rejection of Claim 27 Under 35 USC §112, First Paragraph

In the May 22, 2002 Office Action, claim 27 was rejected under 35 USC §112, first paragraph, based on the recital of the cleaning enhancement agent therein.

In response, claim 27 has been amended herein to recite the cleaning enhancement agent as comprising "an agent for enhancing volatility of metal fluoride species formed by said contacting of the microelectronic device structure with the gas-phase reactive halide composition."

Claim 27 as thus amended is fully consistent with and supported by the disclosure of the specification (see, for example, page 11, line 9-18 of the instant specification).

Claim 27 as thus amended fully complies with the requirements of 35 USC §112, first paragraph. The Examiner therefore is requested to withdraw the §112, first paragraph rejection of claim 27.

Rejection of Claim 24 Under 35 USC §112, Second Paragraph

In the May 22, 2002 Office Action, claim 24 was rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicant regards as the invention.

In response to the rejection, the recitation of "cleaning gas" has been deleted from the claim, and a recitation of "gas-phase reactive halide composition" has been added, which has appropriate antecedent basis in claim 57, from which claim 24 depends. In response to the Examiner's rejection to the Markush group as using the word "and" twice, the claim has been amended to delete such double usage, and the term "radicals" has been inserted after " SiF_2 " to make clear the character of such species. Additionally, claim 24 has been revised to delete the comma after the phrase "microelectronic device structure" and to insert the word "wherein" prior to the definite article preceding such phrase, with repositioning of the comma after the term " SiF_3 radicals" to improve the readability of the claim.

Rejections of Claims 2-4, 12-14 and 57 on Reference Grounds Under 35 USC § 102, and

Traversal Thereof

In the May 22, 2002 Office Action, claims 3, 4, 13, 14 and 57 were rejected under 35 USC § 102(b) as being anticipated by Ashby, et al. U.S. Patent No. 5,814,238 (hereafter "Ashby"), and claims 2-4, 12-14 and 57 were rejected under 35 USC § 102(e) as being anticipated by Smith, et al. U.S. Patent No. 5,911,887 (hereafter "Smith").

These rejections are traversed in view of the amendment of claim 57 herein,

Claim 57 has been amended herein to recite that the contacting of the microelectronic device structure is with "a dry etching agent consisting essentially of (i) a gas-phase reactive halide composition and (ii) optionally, an agent for enhancing volatility of metal fluoride species formed by said contacting of the microelectronic device structure with the gas-phase reactive halide composition (i), to remove the residue, with the proviso that when the dry etching agent is XeF_2 or a sulfur fluoride species, said noble metal residue includes at least one metal selected from the group consisting of palladium, iridium and rhodium."

Claim 57 as amended thus patentably distinguishes over each of Ashby and Smith.

Ashby discloses a method for dry etching of transition metals, requiring "at least one π -acceptor ligand in proximity to the transition metal with each π -acceptor ligand being selected from the group consisting of nitrogen-containing π -acceptor ligands and phosphorous-containing π -acceptor ligands" (column 2, line 64 to column 3, line 1 of Ashby.) Such N- or P-based etchant may be used in connection with a halo species, but in all instances N- or P-based etching agent is required and primary to the etching operation.

group consisting of nitrogen-containing π -acceptor ligands and phosphorous-containing π -acceptor ligands" (column 2, line 64 to column 3, line 1 of Ashby.) Such N-or P-based etchant may be used in connection with a halo species, but in all instances N- or P-based etching agent is required and primary to the etching operation.

By contrast, applicants' amended claim 57 requires a dry etching agent "consisting essentially of (i) a gas-phase reactive halide composition and (ii) optionally, an agent for enhancing volatility of metal fluoride species formed by said contacting of the microelectronic device structure with the gas-phase reactive halide composition (i), to remove the residue, with the proviso that when the dry etching agent is XeF_2 or a sulfur fluoride species, said noble metal residue includes at least one metal selected from the group consisting of palladium, iridium and rhodium."

The applicants' claimed etching method therefore utilizes an etching agent of fundamentally different character, which is simpler and of reduced cost relative to the etching methodology described by Ashby. Further, Ashby contains no teaching or suggestion that the N- or P-etchant species may be omitted - indeed, such species are the fundamental essence of Ashby's methodology and are critical required components of the etching method disclosed in such reference.

Accordingly, amended claim 57 patentably distinguishes from the disclosure of Ashby.

Smith teaches a method of etching a bond pad on a substrate comprising successive layers of a conducting material, an anti-reflective layer, a dielectric and/or a passivation layer. Platinum is disclosed as a material that may be used in the anti-reflective cap or coating layer, or as a conductive layer material, or as a material of fabrication for the etch stop layer.

reflective or etch stop layers, e.g., of platinum. At the same time, Smith in column 5 teaches to utilize halide species for etching anti-reflective coating/etch stop layers.

There is thus some ambiguity as to the specific teaching of Smith, since it contains disclosure of an inconsistent character.

Nonetheless, the only noble metal of the group consisting of platinum, palladium, iridium and rhodium that is disclosed in Smith is platinum. Amended claim 57, however, requires that when the etching agent is XeF_2 or a sulfur fluoride species, the noble metal residue includes at least one metal selected from the group consisting of palladium, iridium and rhodium.

Claim 57 as amended therefore distinguishes from the (however, ambiguous) teachings of Smith.

Claim 57, and claims 2-4 and 12-14 dependent thereunder, are therefore patentably distinguished over Smith.

Addition of New Claims 59- 61

Claims 59 and 61 have been added herein to recite specific aspects of the invention, under claim 57.

Claim 59 depends from claim 57 and recites the noble metal residue as including at least one metal selected from the group consisting of palladium, iridium and rhodium. Claim 60 depends from claim 57 and recites the dry etching agent as including the agent for enhancing volatility of metal fluoride species formed in the contacting step.

Claims 59 and 60 are patentably distinguished over the cited Ashby and Smith references, consistent with the foregoing discussion of such references in relation to independent claim 57, from which claims 59 and 60 each depend.

from claim 57 and recites the dry etching agent as including the agent for enhancing volatility of metal fluoride species formed in the contacting step.

Claims 59 and 60 are patentably distinguished over the cited Ashby and Smith references, consistent with the foregoing discussion of such references in relation to independent claim 57, from which claims 59 and 60 each depend.

Claim 61 has been added consistent with the Examiner's statement of reasons for the indication of allowable subject matter at page 7 of the Office Action (viz., "[t]he etching of iridium XeF_2 constitutes novel and non-obvious subject matter over the references of record that are available as prior art").

Rejection of Claims 2, 53, 57 and 58 Under the Judicially Created Doctrine of Obviousness-Type Double Patenting

Claims 2, 53, 57 and 58 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 13 and 20 of U.S. Patent No. 6,254,792, and claims 2, 57 and 58 have been correspondingly rejected over claims 1, 5, 12-14 and 20 of U.S. Patent No. 6,143,191 on obviousness-type double patenting grounds. These rejections in respect of claims 2, 53, 57 and 58 have been obviated by the terminal disclaimer enclosed herewith, terminally disclaiming the terminal portion of the term of any patent granted on this application that extends beyond the term of U.S. Patent Nos. 6,254,792 and 6,143,191.

Concerning the provisional rejection of claims 2-4, 12-14, 24-27, 53, 57 and 58 based on presently co-pending application no. 09/874,102, the Examiner has characterized the obviousness-type double patenting rejection as provisional "because the conflicting claims have not in fact been patented."

Since the present amendment otherwise resolves all issues of patentability of the claims as amended/added herein, it is requested that such contingent rejection be held in obedience pending disposition of the present application based on this response, since a patent issuing on the present application prior to any patent issued on co-pending application no. 09/874,102 would not require any corresponding terminal disclaimer in this application.

Fee Payable for Added Claims

The addition of claims 59-61 herein does not increase the number of total claims or number of independent claims beyond those for which payment previously has been made.

Nonetheless, if any additional fee or charge is determined to be properly payable in connection with the entry of this amendment, the Commissioner is hereby authorized to charge any deficiency in fees, or credit any overpayment, to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

CONCLUSION

Claims 2-4, 12-14, 24-27, 53 and 57-61 are now in condition for allowance. Favorable action is requested.

If any issues remain outstanding, the Examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss their resolution, so that this application may be passed to issue at an early date.

Respectfully submitted,



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APPENDIX A

(Marked-Up Version of Amended Claims 24-25, 27, 57 and New Claims 59 and 60)

24. (Twice Amended) The method according to claim 57, wherein the noble metal residue comprises iridium, and the [cleaning gas] gas-phase reactive halide composition comprises XeF_2 and at least one [gas phase reactive] halide species selected from the group consisting of SF_6 , SiF_4 , Si_2F_6 [and] SiF_2 radicals and SiF_3 radicals, and wherein the microelectronic device structure[,] is further contacted with a cleaning enhancement agent.
25. (Amended) The method according to claim 24, wherein the cleaning enhancement agent is selected from the group consisting of Lewis-base [adducts] and electron back-bonding species.
27. (Amended) The method according to claim 24 wherein the cleaning enhancement agent comprises an agent for enhancing volatility of iridium fluoride species formed by said contacting of the microelectronic device structure with the gas-phase reactive halide composition [iridium halide species from the group consisting of $\text{Ir}(\text{X})_1$, $\text{Ir}(\text{X})_3$, $\text{Ir}(\text{X})_4$ and $\text{Ir}(\text{X})_6$, wherein X represents the halide of the reactive halide composition].
57. (Amended) A method for removing from a microelectronic device structure a noble metal residue including at least one metal selected from the group consisting of platinum, palladium, iridium and rhodium, the method comprising contacting the microelectronic device structure with a dry etching agent consisting essentially of (i) a gas-phase reactive halide composition and (ii) optionally, an agent for enhancing volatility of metal fluoride species formed by said contacting of the microelectronic device structure with the gas-

phase reactive halide composition (i), to remove the residue, with the proviso that when the dry etching agent is XeF₂ or a sulfur fluoride species, said noble metal residue includes at least one metal selected from the group consisting of palladium, iridium and rhodium.

59. (New) The method according to claim 57, wherein said noble metal residue includes at least one metal selected from the group consisting of palladium, iridium and rhodium.
60. (New) The method according to claim 57, wherein said dry etching agent includes said agent (ii).
61. (New) A method of etching iridium, comprising contacting said iridium with XeF₂.